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EGG GUARDING BY *CLUBIONA CAMBRIDGEI* (ARANEAE, CLUBIONIDAE) AGAINST CONSPECIFIC PREDATORS

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ABSTRACT

Clubiona cambridgei is a vagrant hunting spider that oviposits in silken nests and remains with its eggs. Conspecifics were observed in the field feeding on unattended eggs, an unusual prey for a spider. In the laboratory conspecifics readily ate unattended eggs, but attended eggs were successfully guarded against predation by the resident. This implicates intraspecific egg predation as an important factor favoring maternal females that remain with their eggs. Although "egg guarding" is a label commonly applied when spiders remain with their eggs after oviposition, this is one of the few cases in which the adaptive significance of this behavior has been investigated.

INTRODUCTION

Vagrant hunting spiders commonly oviposit in silken nests and remain with their eggs. Although this behavior is often referred to as "egg guarding" (Bristowe 1958, Clyne 1979, Comstock 1940, Forster and Forster 1973, Gertsch 1949), there is surprisingly little information concerning what is meant by this term. To justify "egg guarding" as a label, the following seem necessary: to specify agents, such as predators and parasites, that constitute a threat to the eggs and to demonstrate that the female spider diminishes this threat by remaining with her eggs.

The life history of *Clubiona cambridgei* (Koch) was studied near Christchurch on the South Island of New Zealand (Pollard, in prep.). This moderately large short-sighted hunting spider (Gertsch 1949) oviposits in silken nests built in dead rolled up leaves of New Zealand flax, *Phormium tenax*. Whenever eggs were found in the field females were almost always with them. In the laboratory maternal females of this largely nocturnal species remained in their nests with their eggs day and night. However there was evidence that three egg batches found unattended in the field had been eaten: each nest was torn open, and the eggs were dry and crushed.

Little is known about the egg predators and parasites of this species. However, on one occasion a female *C. cambridgei* was observed inside a torn open nest with an egg in her chelicerae. On another occasion an inactive female was found in a nest in which all of the eggs were dry and crushed, apparently having been eaten. On yet another occasion a female was outside a nest containing another female and an egg batch. Since the female outside was bleeding from a leg wound, possibly the female inside the nest had just successfully defended her eggs.

These observations suggested a hypothesis which will be stated in two parts: *C. cambridgei* prey on the eggs of conspecifics when the opportunity arises; and by remaining with their eggs, females diminish predation on their eggs (oophagy) by conspecific spiders.

Some experiments were designed to investigate the two components of this hypothesis and some related issues (comparison of the predatory responses to eggs of maternal and non-maternal females and of males and females).

METHODS

Spiders.—Females that were collected from nests with viable eggs were referred to as "maternal." Females that were not located in nests were referred to as "non-maternal." Females with enlarged abdomens were presumably gravid and were not used in this study. All spiders were kept individually in cages constructed from 75 x 25 mm transparent glass vials with cotton wads providing moisture.

Handling and Testing Procedures.—A test consisted of introducing one spider, the "intruder," into the cage with either attended or unattended eggs. No spider was used in more than one test. All tests began at 1400 hr. In tests with unattended eggs, each cage was checked at irregular intervals. After 48 hr the intruder was removed, and the nests were opened and examined for evidence of predation. In tests with attended eggs, each intruder was placed in the cage with the resident and observed for 30 min timed from initial contact with the nest. Chi square tests of independence, with Yates' Correction, and t-tests were carried out as described by Sokal and Rohlf (1969).

Types of Tests.—1. Unattended clubionid eggs. Intruder: Non-maternal female. Twenty four nests containing females with their eggs were collected from the field on the same day as testing by cutting each flax leaf ca 1 cm to either side of the nest. Part of the folded leaf was cut away to facilitate viewing. After prodding females out of their nests, without significantly damaging the silk, the leaves were placed individually in cages. Twenty four non-maternal females were collected on the same day, and each was tested with a different unattended egg case.

2. Unattended clubionid eggs. Intruder: Maternal female. These tests were carried out as for Type 1 except in this case the maternal females removed from their nests were used as the intruders. They were collected on the same day as the test, and each was introduced to a cage with the unattended eggs of another female. Twenty maternal females were tested.

3. Unattended clubionid eggs. Intruder: Male. Except for the use of males as intruders these tests were identical to Type 1.

4. Attended clubionid eggs. Intruder: non-maternal female. The residents were 20 maternal females attending eggs they oviposited in the laboratory. The 20 intruders were each introduced singly to cages with different residents.

5. Attended clubionid eggs. Intruder: Male. Except for the use of males as intruders these were the same as Type 4.

RESULTS

Each of the 24 non-maternal females in Type 1 tests consumed all of the unattended clubionid eggs before the test ended, but none of the 20 non-maternal females in Type 4 tests ate any of the attended eggs (X^2 = 40.059, $P < 0.005$). In contrast to the 24 non-maternal females in Type 1 tests, none of the 20 maternal females in Type 2 tests (X^2 = 40.059, $P < 0.005$) and non of the 20 males in Type 3 tests (X^2 = 40.059, $P < 0.005$) ate unattended eggs. Also, as with females, none of the males ate attended eggs. Males walked away from the nest after contact or courted (abdomen twitching) briefly on the empty nests (Pollard and Jackson, 1982).

Each time a non-maternal female or a male contacted a nest with attended eggs, the resident became active and the intruder soon ran away. In contrast, non-maternal females rapidly entered nests with unattended eggs. Three were observed feeding on the eggs within 5 min of introduction into the cage; nine were observed feeding within 30 min; and each of the 24 had completed eating all of the eggs by the end of 16 hr. However, each remained in the nest until the 48 hr test-period had elapsed.

DISCUSSION

Egg Attendance as Guarding.—The following observations are consistent with *C. cambridgei* being important predators of the eggs of conspecifics: predation on eggs was observed in nature, unattended eggs were readily consumed in the laboratory, and this species is very abundant in nature. Since attended eggs were not eaten in the laboratory by the intruders, "guarding" seems an appropriate label for egg attendance in this species.

Spiders as Predators of Eggs.—Spiders are generally described as predators of motile insects (Clyne 1979, Comstock 1940, Forster and Forster 1973, Gertsch 1949, Main 1976, Turnbull 1973). However, there are some significant exceptions. Some lycosids scavenge on dead insects (Knost and Rovner 1975), and certain salticids have been reported feeding on the eggs of insects (Hensley 1971, Hensley et al. 1961, Jennings and Houseweart 1978, Whitcomb and Bell 1964, Whitcomb and Tadic 1963). Female spiders sometimes eat their own inviable eggs (Kaston 1965), and recently hatched spiderlings of *Achaearanea tepidariorum* (Theridiidae) have been observed feeding on sibling eggs before leaving the egg case (Valerio 1974).

Predation on eggs of conspecifics is a type of cannibalism (Fox 1975, Polis 1981). Although cannibalism is a topic often discussed with reference to spiders, predation on motile conspecifics is the type usually considered. However, the type of oophagy and cannibalism occurring in *C. cambridgei* is different from that usually associated with spiders since the eggs are not potential offspring or siblings, although similar oophagy has been reported in a web-building salticid, *Portia fimbriata* (Jackson 1982, Jackson and Blest 1982). Since the nutritive value of eggs including the yolk provided by the mother for the developing embryo would seem relatively great compared to many potential prey (Polis 1981) perhaps predation on eggs is more widespread in spiders than generally realized.

Comparison of Males and Females.—In contrast to females, males never fed on eggs of conspecifics. The males of many species of spiders and other animals seem to have a life-style that emphasizes locating, courting and mating with females, presumably at some cost to adaptations that prolong survival (Ghiselin 1974, Jackson 1978). This is probably true of *C. cambridgei* also. That the males generally responded to the nests of females in a sexual rather than a predatory fashion is consistent with this hypothesis. Also, because males are most often smaller than females (males: 8.3 ± 1.02 mm, $N = 88$; females: 9.8 ± 1.20 mm, $N = 152$; data expressed as mean ± s.d.; $t = 9.80$, $P < 0.001$), attempted predation on eggs may be more risky for them than for the non-maternal females.

Maternal Compared with Non-maternal Females.—Obviously, inhibitions against eating their own eggs are necessary in order for egg guarding by females to evolve. Since females remain with their eggs after oviposition, an ability to discriminate between their own eggs and those of other females and to prey on the latter only would not seem subject to natural selection; and the failure of maternal females to consume the eggs of other females is consistent with this. However, it is not simply that maternal *C. cambridgei* do not eat. When a sample of five females removed from their eggs were provided with *Drosophila melanogaster* on the same day, they readily captured and fed on these prey.

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